

1 **CLAIMS**

2       1. A processor-readable medium comprising processor-executable  
3 instructions for:

4           sending test data to a plurality of clients;  
5           receiving a rate  $R_i$  which is based at least in part on a rate at which the test  
6 data was received by at least some of the plurality of clients; and  
7           calculating a rate  $R_0$  at which to send an image to the plurality of clients,  
8 wherein the rate  $R_0$  is a function of at least some of the  $R_i$ .

9  
10       2. The processor-readable medium as recited in claim 1, wherein  
11 sending test data comprises instructions for sending test data to the plurality of  
12 clients by operation of a reliable multicast session.

13  
14       3. The processor-readable medium as recited in claim 1, wherein  
15 sending test data comprises instructions for:

16           sending an initial transmission of test data;  
17           setting a timer; and  
18           sending additional test data until the timer expires.

19  
20       4. The processor-readable medium as recited in claim 1, wherein  
21 sending test data comprises instructions for sending a portion of the image at an  
22 initial transfer rate.

1           5.     The processor-readable medium as recited in claim 1, wherein  
2 sending test data comprises instructions for:

3                 sending a first portion of the image at a first rate; and  
4                 sending a second portion of the image at a second rate.

5  
6           6.     The processor-readable medium as recited in claim 1, wherein  
7 sending test data comprises instructions for varying an amount of test data sent to  
8 balance reliability and cost.

9  
10          7.     The processor-readable medium as recited in claim 1, wherein  
11 receiving the rate  $R_i$  comprises instructions for receiving a UDP packet from the at  
12 least some of the plurality of clients.

13  
14          8.     The processor-readable medium as recited in claim 1, wherein  
15 receiving the rate  $R_i$  comprises instructions for receiving data-transfer statistics  
16 from the at least some of the plurality of clients.

1           **9.**     The processor-readable medium as recited in claim 1, wherein  
2 receiving the rate  $R_i$  comprises instructions for:

3                 setting a timer to indicate a maximum period of time during which to wait  
4 for a response from the plurality of clients; and

5                 receiving data-transfer statistics from the at least some of the plurality of  
6 clients within the maximum period.

7  
8           **10.**   The processor-readable medium as recited in claim 1, wherein  
9 calculating the rate  $R_0$  comprises instructions for setting  $R_0$  as a function of a  
10 minimal value of the rate  $R_i$  for all  $i$ .

11  
12           **11.**   The processor-readable medium as recited in claim 1, wherein  
13 calculating the rate  $R_0$  comprises instructions for:

14                 dividing the plurality of clients into at least two groups; and

15                 setting  $R_0$  equal to a minimum  $R_i$  associated with clients within one of the at  
16 least two groups.

17  
18           **12.**   The processor-readable medium as recited in claim 1, wherein  
19 calculating the rate  $R_0$  comprises instructions for:

20                 selecting one of the  $R_i$ ; and

21                 setting  $R_0$  equal to the selected  $R_i$ , less a de-rating factor.  
22  
23  
24  
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1           **13.** The processor-readable medium as recited in claim 12, wherein  
2 selecting one of the  $R_i$  comprises instructions for:  
3           forming at least two groups of clients; and  
4           selecting the smallest  $R_i$  associated with a client from within the at least two  
5 groups of clients.

6  
7           **14.** The processor-readable medium as recited in claim 1, additionally  
8 comprising instructions for sending the image at the rate  $R_0$  during a first multicast  
9 session.

10  
11           **15.** The processor-readable medium as recited in claim 14, additionally  
12 comprising instructions for:

13           opening a second multicast session; and  
14           sending the image at a rate less than  $R_0$  in the second multicast session.

15  
16           **16.** A processor-readable medium comprising processor-executable  
17 instructions for:

18           receiving test data from a server;  
19           calculating a value for  $R_i$  based at least in part on a rate at which the test  
20 data was received; and  
21           sending the rate  $R_i$  to the server.

22  
23           **17.** The processor-readable medium as recited in claim 16, wherein the  
24 test data was received during a reliable multicast session.

25

1           **18.**   The processor-readable medium as recited in claim 16, wherein  
2 receiving the test data comprises instructions for:

3           receiving an initial transmission of test data;  
4           setting a timer; and  
5           receiving additional test data until the timer expires.

6  
7           **19.**   The processor-readable medium as recited in claim 16, wherein  
8 receiving the test data comprises instructions for receiving a portion of the image  
9 at an initial transfer rate.

10  
11           **20.**   The processor-readable medium as recited in claim 16, wherein  
12 receiving the test data comprises instructions for:

13           decrypting and decompressing the initial transmission of test data; and  
14           writing the decrypted and decompressed test data to a disk.

15  
16           **21.**   The processor-readable medium as recited in claim 16, wherein  
17 sending the  $R_i$  comprises instructions for sending a UDP packet to the server.

18  
19           **22.**   The processor-readable medium as recited in claim 16, wherein  
20 sending the rate  $R_i$  comprises instructions for sending data-transfer statistics  
21 including the rate  $R_i$  to the server in a UDP packet.

22  
23           **23.**   The processor-readable medium as recited in claim 16, wherein  
24 calculating the rate  $R_i$  comprises instructions for setting the rate  $R_i$  equal to an  
25 average rate at which data was received.

1  
2       **24.**   The processor-readable medium as recited in claim 16, wherein  
3 calculating the rate  $R_i$  comprises instructions for setting rate  $R_i$  equal to a  
4 minimum rate at which data was received.

5  
6       **25.**   The processor-readable medium as recited in claim 16, wherein  
7 calculating the rate  $R_i$  comprises instructions for:  
8       setting the rate  $R_i$  as a function of the rate at which data was received; and  
9       de-rating the rate  $R_i$  to result in a safer value.

10  
11       **26.**   The processor-readable medium as recited in claim 16, additionally  
12 comprising instructions for receiving an image at a rate  $R_0$  during a first multicast  
13 session if  $R_0$  is less than  $R_i$ .

14  
15       **27.**   The processor-readable medium as recited in claim 26, additionally  
16 comprising instructions for receiving the image during a second multicast session  
17 if  $R_0$  is more than  $R_i$ .

1       **28.**   A method for determining a transfer rate to multicast an image,  
2 comprising:  
3       sending test data from a server to a plurality of clients;  
4       calculating  $R_i$  values for at least some of the plurality of clients based at  
5 least in part on rate of receipt of the test data;  
6       sending the  $R_i$  values from each of the plurality of clients to the server; and  
7       calculating a rate  $R_0$  at which to send an image from the server to the  
8 plurality of clients, wherein the rate  $R_0$  is a function based at least in part on at  
9 least some of the  $R_i$  values.

10  
11       **29.**   The method as recited in claim 28, wherein the test data is sent over  
12 a reliable multicast session.

13  
14       **30.**   The method as recited in claim 28, wherein sending test data  
15 comprises:

16       sending an initial transmission of test data from the server;  
17       setting a timer on the server;  
18       receiving the initial transmission of the test data on each client;  
19       setting a timer on each client;  
20       sending additional test data until the timer on the server expires.

21  
22       **31.**   The method as recited in claim 28, wherein sending test data  
23 comprises sending a portion of the image at an initial transfer rate.

1           **32.** The method as recited in claim 28, wherein sending test data  
2 comprises:

3           sending a first portion of the image at a first rate; and  
4           sending a second portion of the image at a second rate.

5  
6           **33.** The method as recited in claim 28, wherein the test data is:  
7           a selected percentage of the image;  
8           a selected amount of data obtained from the image; or  
9           data obtained from the image of a size calculated for transmission within a  
10 selected period of time.

11  
12           **34.** The method as recited in claim 28, wherein the  $R_i$  values are sent  
13 from at least some of the plurality of clients to the server via a UDP packet.

14  
15           **35.** The method as recited in claim 28, wherein sending  $R_i$  values  
16 comprises:

17           setting a timer on the server to indicate a maximum period of time during  
18 which the server will wait for a response from the plurality of clients; and

19           transferring data-transfer statistics from the plurality of clients to the server  
20 within the maximum period.

21  
22           **36.** The method as recited in claim 28, wherein calculating the rate  $R_0$   
23 comprises setting the rate  $R_0$  equal to a minimum of the  $R_i$  values for all  $i$ .



1       **37.** The method as recited in claim 28, wherein calculating the  $R_0$   
2 comprises:

3       dividing the plurality of clients into at least two groups; and  
4       setting  $R_0$  as a function of a minimum  $R_i$  associated with clients within one  
5 of the at least two groups.

6  
7       **38.** The method as recited in claim 28, wherein calculating the  $R_0$   
8 comprises:

9       selecting one of the  $R_i$ ; and  
10       setting  $R_0$  as a function of the selected  $R_i$ , less a de-rating factor.

11  
12       **39.** The method as recited in claim 28, wherein calculating the rate  $R_0$   
13 comprises:

14       forming at least two groups of clients, wherein the forming is based on the  
15  $R_i$ 's of the clients;

16       selecting a smallest  $R_i$  associated with a client from within the at least two  
17 groups of clients; and

18       setting  $R_0$  as a function of the selected smallest  $R_i$ .

19  
20       **40.** The method as recited in claim 28, additionally comprising sending  
21 the image at the rate  $R_0$  during a first multicast session.

22  
23       **41.** The method as recited in claim 40, additionally comprising:

24       opening a second reliable multicast session; and

25       sending in the second multicast session at a rate less than  $R_0$ .

1       **42.**    A server, comprising:  
2            means for sending test data to a plurality of clients, wherein the test data is a  
3   subset of an image to be sent to the plurality of clients;  
4            means for receiving a rate  $R_i$  based at least in part on a rate at which the test  
5   data was received by at least one of the plurality of clients; and  
6            means for calculating a rate  $R_0$  at which to send the image to the plurality of  
7   clients, wherein the rate  $R_0$  is a function of the  $R_i$ .

8  
9       **43.**    The server as recited in claim 42, wherein the means for sending test  
10   data comprises means for operating a reliable multicast session.

11  
12       **44.**    The server as recited in claim 42, wherein the means for calculating  
13   the  $R_0$  comprises means for setting the rate  $R_0$  equal to a minimum value of the  
14   rate  $R_i$  for all  $i$ .

15  
16       **45.**    The server as recited in claim 42, wherein the means for calculating  
17   the  $R_0$  comprises:

18            means for dividing the plurality of clients into at least two groups; and  
19            means for setting  $R_0$  equal to a minimum  $R_i$  associated with clients within  
20   one of the at least two groups.

1           **46.**    The server as recited in claim 42, wherein the means for sending test  
2 data is configured to send:

3           a selected percentage of the image;  
4           a selected amount of data obtained from the image; or  
5           data obtained from the image of a size calculated for transmission within a  
6 selected period of time.

7  
8           **47.**    The server as recited in claim 42, additionally comprising means for  
9 sending the image at the rate  $R_0$  during a first multicast session.

10  
11           **48.**    The server as recited in claim 42, wherein the means for receiving  
12 the rate  $R_i$  comprises:

13           means for setting a timer to indicate a maximum period of time during  
14 which to wait for a response from the plurality of clients; and

15           means for receiving data-transfer statistics from the at least some of the  
16 plurality of clients within the maximum period.

17  
18           **49.**    The server as recited in claim 42, wherein the means for sending test  
19 data comprises means for setting a timer to indicate a maximum period of time  
20 during which to send the test data to the plurality of clients  
21  
22  
23  
24  
25

1           **50.**    A client, comprising:  
2                means for receiving test data from a server during a reliable multicast  
3 session, comprising:  
4                means for receiving an initial transmission of test data comprising a  
5 portion of an image at an initial transfer rate;  
6                means for setting a timer; and  
7                means for receiving additional test data until the timer expires;  
8                means for calculating a rate  $R_i$  based at least in part on a rate at which the  
9 test data was received; and  
10              means for sending the rate  $R_i$  to the server.

11  
12           **51.**    The client as recited in claim 50, wherein the means for receiving  
13 test data additionally comprises:  
14                means for decrypting and decompressing the received test data; and  
15                means for writing the decrypted and decompressed test data to a disk.

16  
17           **52.**    The client as recited in claim 50, wherein the means for sending the  
18 rate  $R_i$  comprises means for sending data-transfer statistics including the rate  $R_i$  to  
19 the server in a UDP packet.  
20  
21  
22  
23  
24  
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1           **53.**    The client as recited in claim 50, wherein the means for calculating  
2 the  $R_i$  comprises means for setting  $R_i$  equal to an average rate at which the test data  
3 was received.

4  
5           **54.**    The client as recited in claim 50, wherein the means for calculating  
6 the rate  $R_i$  comprises means for setting the rate  $R_i$  equal to a minimum rate at  
7 which the test data was received.

8  
9           **55.**    The client as recited in claim 50, wherein the means for calculating  
10 the  $R_i$  comprises:

11               means for setting the rate  $R_i$  as a function of a rate at which the test data  
12 was received; and

13               means for de-rating the rate  $R_i$  to result in a safer value.

14  
15           **56.**    The client as recited in claim 50, additionally comprising means for  
16 receiving the image at a rate  $R_0$  during a first multicast session if the rate  $R_0$  is less  
17 than the rate  $R_i$ .

18  
19           **57.**    The client as recited in claim 50, additionally comprising instructions  
20 for means for allowing the client to receive the image during a second multicast  
21 session if the rate  $R_0$  is more than the rate  $R_i$ .

1           **58.**    A server, comprising:  
2           a test data generation module to generate test data for transmission to a  
3 plurality of clients, wherein the test data is a subset of an image to be sent to the  
4 plurality of clients; and  
5           an  $R_0$  calculation module to receive a rate  $R_i$  at which the test data was  
6 received by at least some of the plurality of clients and to calculate a rate  $R_0$  at  
7 which to send the image to the plurality of clients, wherein the rate  $R_0$  is a function  
8 of the rate  $R_i$ .

9  
10           **59.**    The server as recited in claim 58, wherein the test generation module  
11 is configured to send the test data to the plurality of clients by operation of a  
12 reliable multicast session.

13  
14           **60.**    The server as recited in claim 58, wherein the  $R_0$  calculation module  
15 is configured to set the rate  $R_0$  equal to a minimum value of the rate  $R_i$  for all  $i$ .

16  
17           **61.**    The server as recited in claim 58, wherein the  $R_0$  calculation module  
18 is additionally configured to:

19           divide the plurality of clients into at least two groups; and  
20           set the rate  $R_0$  equal to a minimal value of the rate  $R_i$  associated with clients  
21 within one of the at least two groups.

1           **62.**    The server as recited in claim 58, wherein the test data generation  
2 module is configured to send:  
3           a selected percentage of the image;  
4           a selected amount of data obtained from the image; or  
5           data obtained from the image of a size calculated for transmission within a  
6 selected period of time.

7  
8           **63.**    The server as recited in claim 58, additionally comprising:  
9           a data communication module configured to set a timer to indicate a  
10 maximum period of time during which to wait for receipt of data-transfer statistics  
11 from the plurality of clients.

12  
13           **64.**    A client, comprising:  
14           a data reception module to receive test data from a server during a reliable  
15 multicast session, wherein the test data reception module is additionally configured  
16 to:  
17                receive an initial transmission of test data comprising a portion of an  
18                image at an initial transfer rate;  
19                set a timer; and  
20                receive additional test data until the timer expires;  
21           an  $R_i$  calculation module to calculate a rate  $R_i$  based at least in part on a rate  
22 at which the test data was received; and  
23           an  $R_i$  management module to transmit the rate  $R_i$  to the server.  
24  
25

1       **65.**    The client as recited in claim 64, wherein the data reception module  
2 is additionally configured for:

3       decrypting and decompressing the received test data; and  
4       writing the decrypted and decompressed test data to a disk.  
5

6       **66.**    The client as recited in claim 64, wherein the  $R_i$  management module  
7 transmits the rate  $R_i$  via a UDP packet to the server.  
8

9       **67.**    The client as recited in claim 64, wherein the  $R_i$  calculation module  
10 is configured to set the rate  $R_i$  equal to an average rate at which the test data was  
11 received.  
12

13       **68.**    The client as recited in claim 64, wherein the  $R_i$  calculation module  
14 is configured to set the rate  $R_i$  equal to a minimum rate at which the test data was  
15 received.  
16

17       **70.**    The client as recited in claim 64, wherein the  $R_i$  calculation module  
18 is configured to set the rate  $R_i$  as a function of a rate at which data was received  
19 and to de-rate the rate  $R_i$  to result in a safer value.  
20

21       **71.**    The client as recited in claim 64, wherein the data reception module  
22 is configured to receive the image at a rate  $R_0$  during a first multicast session if  $R_0$   
23 is less than  $R_i$ .  
24  
25



1           **72.**    The client as recited in claim 64, wherein the data reception module  
2 is configured to receive the image during a second multicast session if  $R_0$  is more  
3 than  $R_i$ .